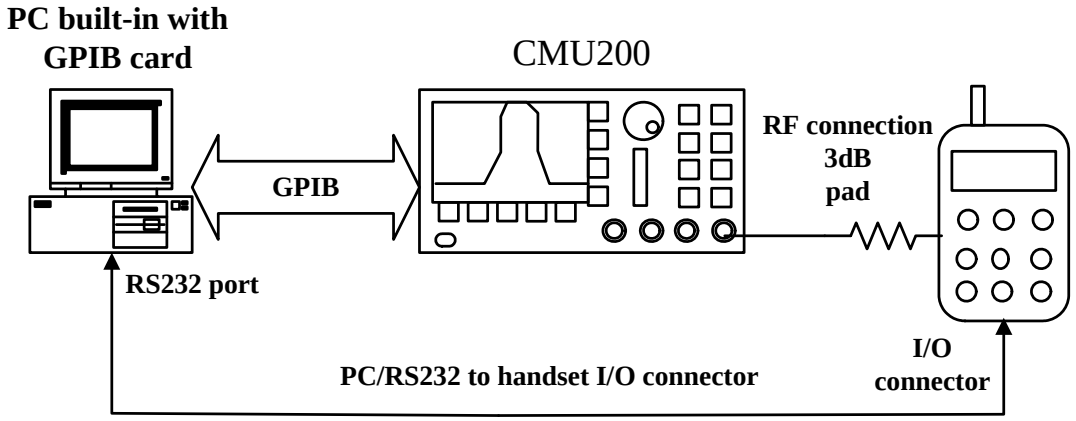
Tune up procedure

It must provide an operational voltage 3.8V to turn on the phone and on one certain channel as following table. And control phone enter test mode by means of company proprietary software.

Band	Low Channel	Mid. Channel	High Channel
GSM850	128	190	251
GSM900	975	40	124
DCS1800	512	700	885
PCS1900	512	661	810

1. The setup:

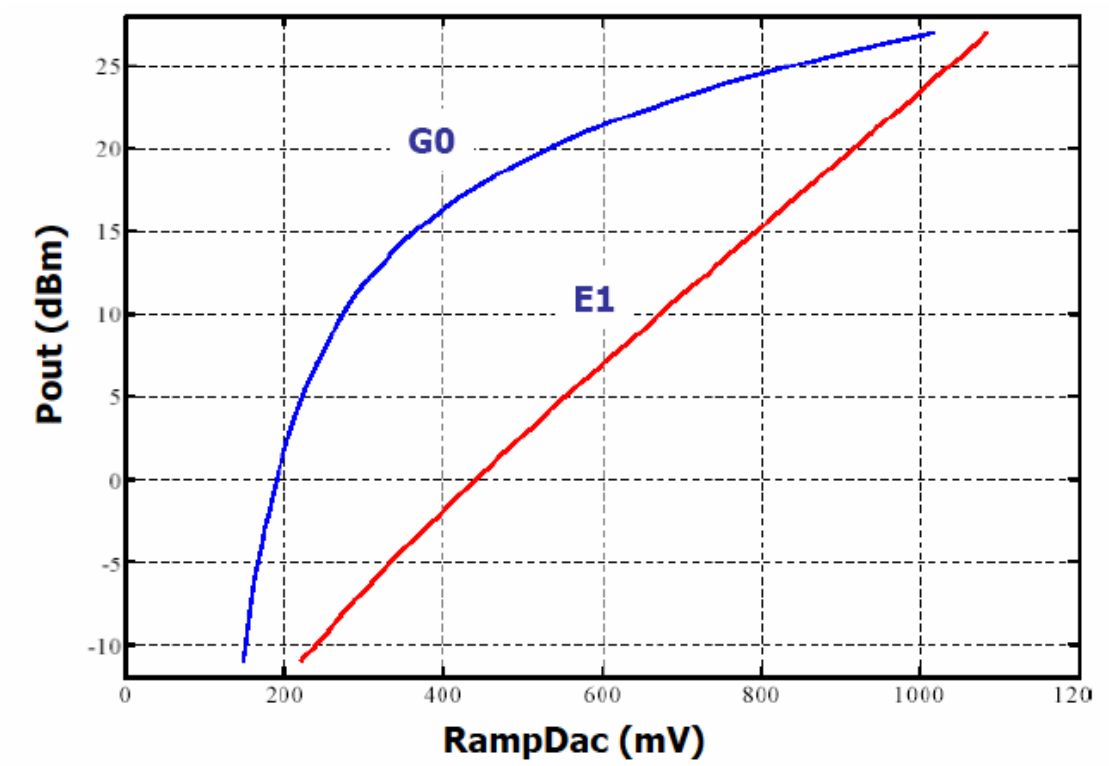
The GPIB connectivity should be ready before calibration starts; in the meanwhile the connectivity between PC and handset shall be settled,



2. PA calibration procedure

For GMSK modulation, low band GSM 850/900 adopts power class 4 using in RF subsystem. For high band DCS/PCS, power class 1 is adopted. For 8- PSK modulation it uses E1 for all bands.

Following shows power curve in G0 mode and E1 mode where G0 means GMSK and E1 means EDGE respectively. In G0 mode, linear scale the curve is linear, it is very convenient to calculate power curve in voltage scale. In E0 mode, log scale the curve is linear, take two points can find slope and offset value along this curve.



In E1 mode, Vramp controls the RF output signal in a LIN-LOG characteristic meaning that the RF output power expressed in [V].

In G0 mode, Vramp controls the RF output signal in a LINEAR characteristic. As a result, the RF output power expressed in [dBm] is a logarithmic function of Vramp.

$$Vout(V) = \sqrt{(50*Pout)} = A*Vramp+B$$

$$Pout(dBm) = 10\log Pout(W)$$

=10log(Vout^2 / 50)

∴ **Pout(dBm)=10log((1000*(A*Vramp+B)^2)/50)** ∴

A, B=constant

A and B is the reference constant for 9036B HPA

	GSM850	GSM900	GSM1800	GSM1900
A	7.5	7.5	6.6	6.1
B	-1.2	-1.2	-1.32	1.22

And example of Vramp and Pout:

GSM power of 9036B				
RampDac [V]	Output power [dBm]	Pout [V]	P(dBm)=10*log((1000*(A*Vramp+B)^2)/50)	Delta[dB]
0.3	-0.8	0.20	-0.8	0.00
0.4	11.6	0.85	12.1	0.48
0.5	17	1.58	17.1	0.05
0.6	20	2.24	20.2	0.19
0.7	22	2.82	22.5	0.50
0.8	24	3.54	24.3	0.31
0.9	25.6	4.26	25.8	0.22
1	26.9	4.95	27.1	0.20
1.1	28.4	5.88	28.2	0.19
1.2	29	6.30	29.2	0.20
1.3	30	7.07	30.1	0.09
1.4	31	7.93	30.9	0.10
1.5	31.7	8.60	31.6	0.07
1.6	32.5	9.43	32.3	0.19

Vout VS Vramp in G0 mode

For G0 mode, by using this formula, index A and index B can be found to estimate predicted power level, only two points needed to calculate.

$$Pout(dBm)=10log((1000*(A*Vramp+B)^2)/50)$$

Or Vout(V)=A*Vramp+B

Power VS Vramp in E0 mode

For E0 mode, the log scale is linear. It is estimated by finding slope and offset value.

$$Pout(dBm)=A*Vramp+B$$

3. The maximum gain of each individual phone are adjusted until the target value met

Calibration Item	Parameter	Band	PCL	Target Power(dBm)	Tolerance (dB)
APC GMSK	**APC5 (MAX)**	**GSM850**	**5**	**31.8**	**+0.3/-0.5**
	APC6		6	30.5	±0.5
	APC7		7	29	±1.5
	APC8		8	27	±1.5
	APC9		9	25	±1.5
	APC10		10	23	±1.5
	APC11		11	21	±1.5
	APC12		12	19	±1.5
	APC13		13	17	±1.5
	APC14		14	15	±1.5
	APC15		15	13	±1.5
	APC16		16	11	±1.5
	APC17		17	9	±1.5
	APC18		18	7	±1.5
	APC19		19	5	±1.5

	APC5 (MAX)	**GSM900**	**5**	**31.8**	**+0.3/-0.5**
	APC6		6	30.5	±0.5
	APC7		7	29	±1.5
	APC8		8	27	±1.5
	APC9		9	25	±1.5
	APC10		10	23	±1.5
	APC11		11	21	±1.5
	APC12		12	19	±1.5
	APC13		13	17	±1.5
	APC14		14	15	±1.5
	APC15		15	13	±1.5
	APC16		16	11	±1.5
	APC17		17	9	±1.5
	APC18		18	7	±1.5
	APC19		19	5	±1.5
	APC0 (MAX)	**DCS1800**	**0**	**29**	**+0.3/-0.5**
	APC1		1	28	±0.5
	APC2		2	26	±1.5
	APC3		3	24	±1.5
	APC4		4	22	±1.5
	APC5		5	20	±1.5
	APC6		6	18	±1.5
	APC7		7	16	±1.5
	APC8		8	14	±1.5
	APC9		9	12	±1.5
	APC10		10	10	±1.5
	APC11		11	8	±1.5
	APC12		12	6	±1.5
	APC13		13	4	±1.5
	APC14		14	2	±1.5
	APC15		15	0	±1.5
	APC0 (MAX)	**PCS1900**	**0**	**29**	**+0.3/-0.5**
	APC1		1	27.5	±0.5
	APC2		2	26	±1.5

	APC3		3	24	±1.5
	APC4		4	22	±1.5
	APC5		5	20	±1.5
	APC6		6	18	±1.5
	APC7		7	16	±1.5
	APC8		8	14	±1.5
	APC9		9	12	±1.5
	APC10		10	10	±1.5
	APC11		11	8	±1.5
	APC12		12	6	±1.5
	APC13		13	4	±1.5
	APC14		14	2	±1.5
	APC15		15	0	±1.5

Calibration Item	**Parameter**	**Band**	**PCL**	**Target Power (dBm)**	Tolerance (dB)
APC EDGE	**APC8 (MAX)**	**GSM850**	**8**	**26**	**+0.3/-0.5**
	APC9		9	24.5	±0.8
	APC10		10	23	±1.5
	APC11		11	21	±1.5
	APC12		12	19	±1.5
	APC13		13	17	±1.5
	APC14		14	15	±1.5
	APC15		15	13	±1.5
	APC16		16	11	± 2.5
	APC17		17	9	± 2.5
	APC18		18	7	± 2.5
	APC19		19	5	± 2.5
	APC8 (MAX)	**GSM900**	**8**	**26**	**+0.3/-0.5**
	APC9		9	25	±0.8
	APC10		10	23	±1.5
	APC11		11	21	±1.5
	APC12		12	19	±1.5

	APC13		13	17	±1.5
	APC14		14	15	±1.5
	APC15		15	13	±1.5
	APC16		16	11	± 2.5
	APC17		17	9	± 2.5
	APC18		18	7	± 2.5
	APC19		19	5	± 2.5
	APC2 (MAX)	**DCS1800**	**2**	**24.4**	**+0.3/-0.5**
	APC3		3	23.5	+/- 0.8
	APC4		4	22	+/- 1.5
	APC5		5	20	+/- 1.5
	APC6		6	18	+/- 1.5
	APC7		7	16	+/- 1.5
	APC8		8	14	+/- 1.5
	APC9		9	12	+/- 2
	APC10		10	10	+/- 2
	APC11		11	8	+/- 2
	APC12		12	6	+/- 2
	APC13		13	4	+/- 2
	APC14		14	2	+/- 2.5
	APC15		15	0	+/- 2.5
	APC2 (MAX)	**PCS1900**	**2**	**24.4**	**+0.3/-0.5**
	APC3		3	23.5	+/- 0.8
	APC4		4	22	+/- 1.5
	APC5		5	20	+/- 1.5
	APC6		6	18	+/- 1.5
	APC7		7	16	+/- 1.5
	APC8		8	14	+/- 1.5
	APC9		9	12	+/- 2
	APC10		10	10	+/- 2
	APC11		11	8	+/- 2
	APC12		12	6	+/- 2
	APC13		13	4	+/- 2
	APC14		14	2	+/- 2.5
	APC15		15	0	+/- 2.5

Maximum power for each band and GSMK and 8-PSK mode are shown in blue.

The user has no possibility to change these settings later on, and during manufacturing each phone will be individual calibrated. The measurement is done in fully calibrated setup, which is based on a Rohde& Schwarz CMU200 base station simulator. Furthermore, the highest power level is verified afterwards in a call measurement on three channels (low, middle and high).